

IEM's AI Modeling: Short-term COVID-19 Projections

Date: 4/2/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 4/2/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

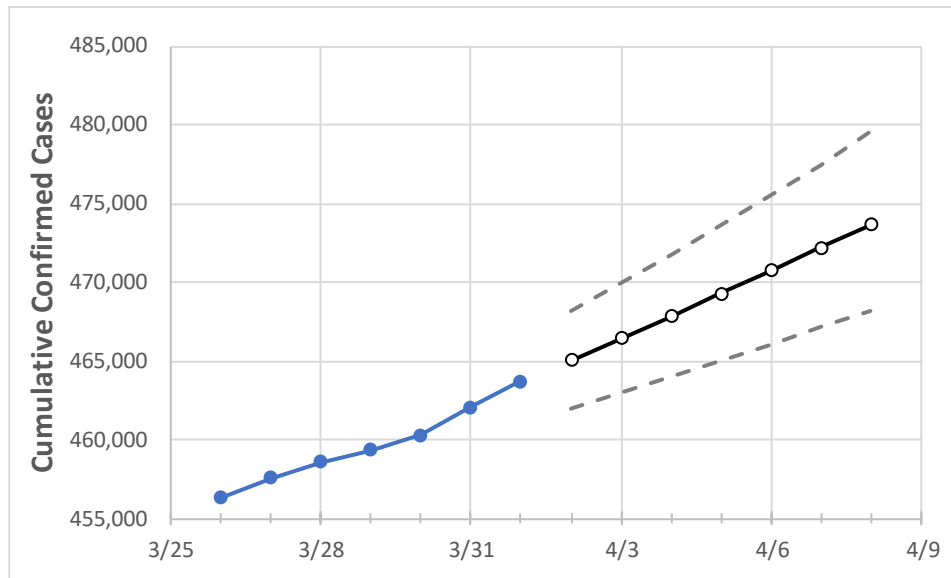
IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

Colorado State Projections



	Actual Confirmed Cases On:				Projected Cases For:							
	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	
Colorado	459,361	460,318	462,081	463,685	465,042	466,437	467,849	469,264	470,714	472,169	473,654	

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:							
	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	
Adams	51,185	51,255	51,362	51,495	51,596	51,693	51,794	51,895	51,999	52,101	52,205	
Arapahoe	51,685	51,762	51,970	52,135	52,270	52,407	52,546	52,690	52,840	52,987	53,139	
Boulder	20,430	20,499	20,593	20,668	20,745	20,825	20,908	20,993	21,077	21,162	21,253	
Denver	63,851	63,964	64,378	64,542	64,737	64,940	65,144	65,356	65,571	65,792	66,011	
Douglas	23,575	23,650	23,752	23,895	23,997	24,099	24,201	24,307	24,414	24,521	24,636	
Eagle	5,694	5,704	5,738	5,756	5,775	5,795	5,815	5,835	5,855	5,875	5,894	
El Paso	56,201	56,416	56,607	56,922	57,133	57,347	57,564	57,793	58,023	58,261	58,501	
Gunnison	1,241	1,242	1,252	1,258	1,261	1,264	1,268	1,271	1,275	1,279	1,283	
Jefferson	40,162	40,260	40,391	40,529	40,642	40,754	40,870	40,984	41,101	41,218	41,340	
Larimer	22,109	22,157	22,286	22,407	22,508	22,611	22,718	22,825	22,938	23,048	23,166	
Pueblo	15,748	15,766	15,830	15,876	15,919	15,967	16,017	16,068	16,121	16,179	16,237	
Weld	27,337	27,385	27,476	27,578	27,654	27,729	27,807	27,887	27,966	28,047	28,128	

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- **Beds:** For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report ([MMWR, March 18, 2020](#)) and state reports of COVID-19 cases.
- **ICU:** The CDC report found that 24% of hospitalized cases require ICU care.
- **Ventilators:** Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.

Colorado Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:							
	3/29	3/30	3/31	4/1	4/3		4/5		4/7			
Adams	51,185	51,255	51,362	51,495	51,693	(10,339) [2,481] {1,241}	51,895	(10,379) [2,491] {1,245}	52,101	(10,420) [2,501] {1,250}		
Arapahoe	51,685	51,762	51,970	52,135	52,407	(10,481) [2,516] {1,258}	52,690	(10,538) [2,529] {1,265}	52,987	(10,597) [2,543] {1,272}		
Boulder	20,430	20,499	20,593	20,668	20,825	(4,165) [1,000] {500}	20,993	(4,199) [1,008] {504}	21,162	(4,232) [1,016] {508}		
Denver	63,851	63,964	64,378	64,542	64,940	(12,988) [3,117] {1,559}	65,356	(13,071) [3,137] {1,569}	65,792	(13,158) [3,158] {1,579}		
Douglas	23,575	23,650	23,752	23,895	24,099	(4,820) [1,157] {578}	24,307	(4,861) [1,167] {583}	24,521	(4,904) [1,177] {589}		
Eagle	5,694	5,704	5,738	5,756	5,795	(1,159) [278] {139}	5,835	(1,167) [280] {140}	5,875	(1,175) [282] {141}		
El Paso	56,201	56,416	56,607	56,922	57,347	(11,469) [2,753] {1,376}	57,793	(11,559) [2,774] {1,387}	58,261	(11,652) [2,797] {1,398}		
Gunnison	1,241	1,242	1,252	1,258	1,264	(253) [61] {30}	1,271	(254) [61] {31}	1,279	(256) [61] {31}		
Jefferson	40,162	40,260	40,391	40,529	40,754	(8,151) [1,956] {978}	40,984	(8,197) [1,967] {984}	41,218	(8,244) [1,978] {989}		
Larimer	22,109	22,157	22,286	22,407	22,611	(4,522) [1,085] {543}	22,825	(4,565) [1,096] {548}	23,048	(4,610) [1,106] {553}		
Pueblo	15,748	15,766	15,830	15,876	15,967	(3,193) [766] {383}	16,068	(3,214) [771] {386}	16,179	(3,236) [777] {388}		
Weld	27,337	27,385	27,476	27,578	27,729	(5,546) [1,331] {665}	27,887	(5,577) [1,339] {669}	28,047	(5,609) [1,346] {673}		

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.